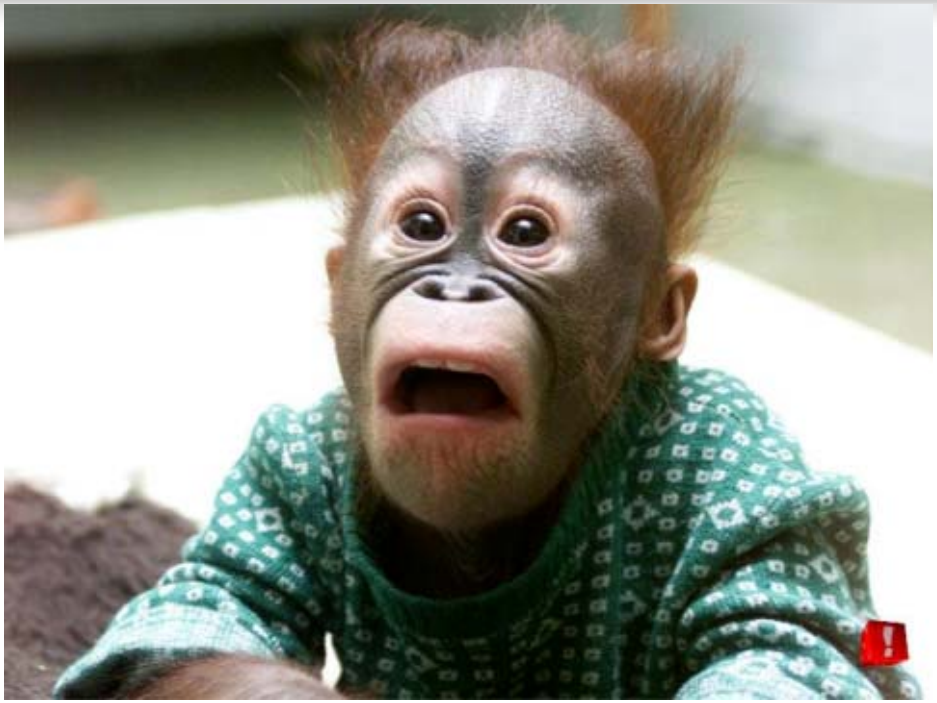
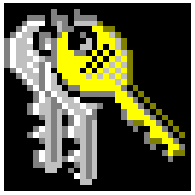
Red Revert for Backup Protection

D. Todd Joyce



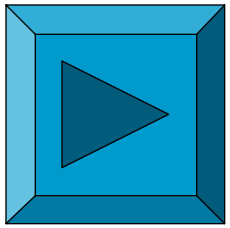
“The Yellow Trap”

- Why use backup protection?
- Primary concern is “the yellow trap”
- Definition
  - Phase progression involving the return to a fully protected movement opposite a terminating permissive movement. At the onset of the yellow indication for the terminating permissive movement a driver can have the mistaken impression that both directions are terminating and proceed with the left turn into oncoming traffic



Yel_trap.swf

‘Yellow Trap’ animation



What is backup protection?

- A means of avoiding the ‘yellow trap’
- A means to avoid backing up from concurrent through phases to a fully protected left turn movement opposing a permissive left turn movement
- motorist must wait for a gap in traffic sufficient to safely execute the turn or allow the signal to transition through the side street or transition through all-red interval

Backup protection options

- Phase omits (hardwire/software driven)
- omit phase/force to side street (relay/software driven)
- ‘dummy all-red’

OASIS and backup protection

Dynamic/Backup Control functions

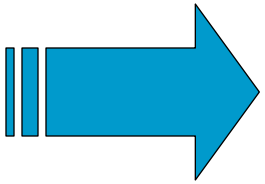
- conditional phase omit/call
- phase is omitted upon service of another (selected) phase
- upon demand for omitted phase a selected phase is called

Backup Protect function

- all red display

Signal Plan with Dynamic/Backup Control

- Signal plan notes
- assigned per function



NOTES

1. Refer to "Roadway Standard Drawings NCDOT" dated July 2006 and "Standard Specifications for Roads and Structures" dated July 2006.
2. Do not program signal for late night flashing operation unless otherwise directed by the Engineer.
3. Omit phase 1 during phase 2 on.
4. Omit phase 5 during phase 6 on.
5. Program controller to clear from phase 2+6 to phase 1 and/or 5 by progressing through phase 4+8 (see Electrical Details).
6. Set all detector units to presence mode.
7. Locate new cabinet so as not to obstruct sight distance of vehicles turning right on red.
8. Maximum times shown in timing chart are for free-run operation only. Coordinated signal system timing values supersede these values.
9. Closed loop system data: Controller Asset #0830.

Dynamic/Backup Control Functions menu

- phase omits
- phase call

```
   OASIS LOCAL CONTROLLER MAIN MENU:
1 STATUS DISPLAYS      8 OVERLAPS
2 PHASE CONTROL        9 COORDINATION
3 PHASE TIMING         A PREEMPTION
4 PHASE SEQUENCE       B SCHEDULING
5 INPUTS               C USER PROFILES
6 OUTPUTS              D GENERAL MENU
7 DETECTORS            E EXIT
```

From main menu
press ‘2’ (PHASE CONTROL)

```
   PHASE CONTROL FUNCTIONS MENU:
1...PHASE CONTROL FUNCTIONS
2...DYNAMIC/BACKUP CONTROL FUNCTIONS
```

Next, press ‘2’
(DYNAMIC/BACKUP CONTROL FUNCTIONS)

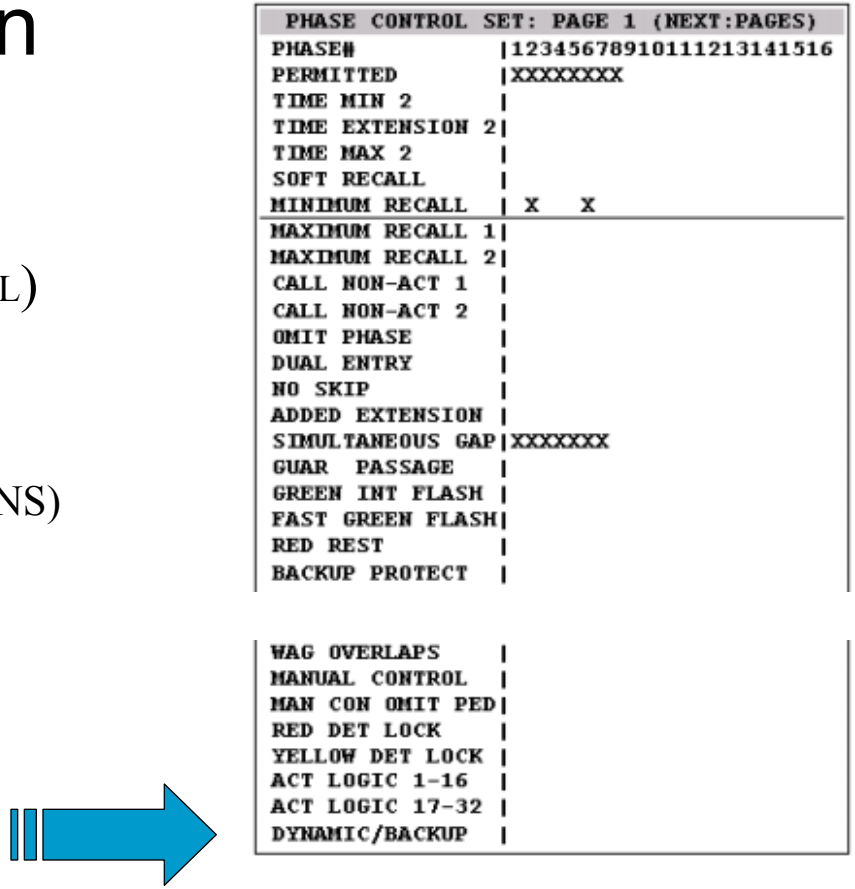
```
 DYNAMIC/BACKUP CONTROL FUNCTION #01
                OVERLAPS:|ABCDEFGHIJKLMNOP
IF OVERLAPS ARE ACTIVE  |
OR        PHASES:|12345678910111213141516
IF PHASES ARE ON|
OMIT PHASES     |
CALL PHASES     |
```

Dynamic/Backup Control Function

- Phase Control Functions menu
- enable function

From main menu
press ‘2’ (PHASE CONTROL)

Next, press ‘1’
(PHASE CONTROL FUNCTIONS)



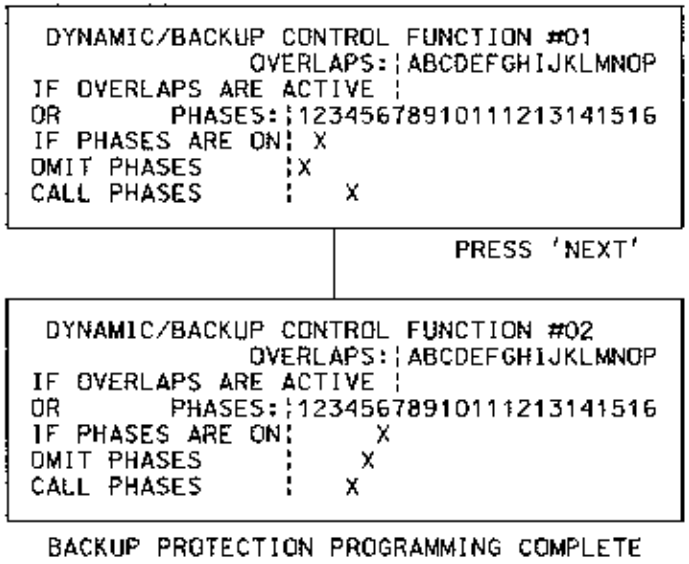
Electrical and Programming Detail

DYNAMIC BACK-UP CONTROL PROGRAMMING

(program controller as shown below)

1. From Main Menu press '2' (Phase Control), then '1' (Phase Control Functions). Scroll to the bottom of the menu and enable Dynamic/Backup Control Functions 1 and 2.

2. From Phase Control Functions Menu press '2' (Dynamic/Backup Control Functions).



BACKUP PROTECTION PROGRAMMING COMPLETE

OASIS and Backup Protect

Backup Protect causes selected phase to revert to red

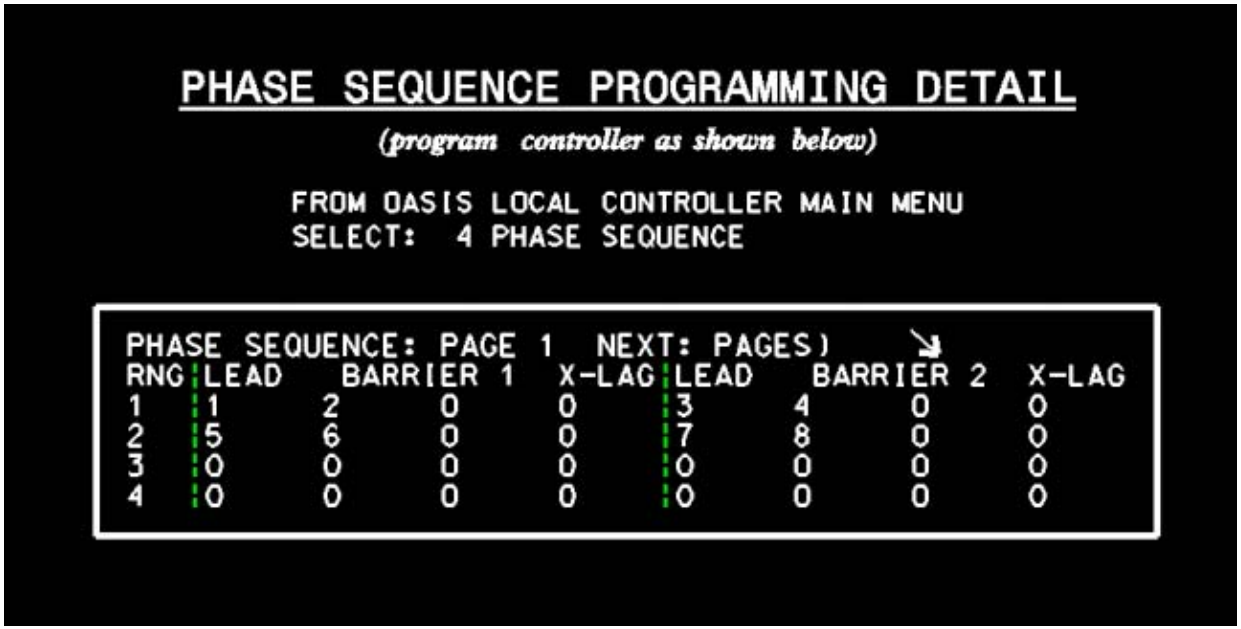
BACKUP PROTECTION NOTE

From Main Menu press '2' (Phase Control), then '1' (Phase Control Functions). Program phase 6 for 'Backup Protect'. Make sure the Red Revert times shown on the Signal Design Plans are programmed in the 'Phase Timing' menu.

OASIS and Backup Protect

- A phase selected for Backup Protect will revert to red if the next phase to be served is a previous phase in the same barrier
- When a terminating phase is to be immediately re-serviced the Red Revert interval times between the end of the yellow change interval and the onset of the green
- This interval becomes the red clearance interval for this phase sequence

Phase Sequencer



PHASE SEQUENCE PROGRAMMING DETAIL

(program controller as shown below)

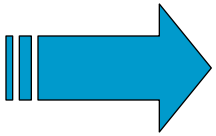
FROM OASIS LOCAL CONTROLLER MAIN MENU
SELECT: 4 PHASE SEQUENCE

PHASE SEQUENCE: PAGE 1 NEXT: PAGES)

RNG	LEAD	BARRIER 1		X-LAG	LEAD	BARRIER 2		X-LAG
1	1	2	0	0	3	4	0	0
2	5	6	0	0	7	8	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0

Signal Plan w/Backup Protect

- Signal plan notes
- assigned per phase

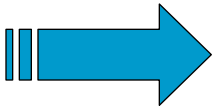


NOTES

1. Refer to "Roadway Standard Drawings NCDOT" dated July 2006 and "Standard Specifications for Roads and Structures" dated July 2006.
2. Do not program signal for late night flashing operation unless otherwise directed by the Engineer.
3. Enable Backup Protect for phase 2 and 6 to allow the controller to clear from phase 2+6 to phase 1+6 or 2+5 by progressing through an all red display.
4. The order of phase 3 and phase 4 may be reversed.
5. Set all detector units to presence mode.
6. Existing "Left Turn Yield on Green" ball signs (R10-12) may be removed at the discretion of the Regional Traffic Engineer.
7. Pavement markings are existing unless otherwise shown.

Signal Plan w/Backup Protect

- Timing Chart
- Red Revert timing



2070L TIMING CHART

FEATURE	PHASE 1	2	3	4	5	6
Min Green 1 *	7	12	7	7	7	12
Extension 1 *	1.0	2.0	1.0	1.0	1.0	2.0
Max Green 1 *	15	50	35	35	25	50
Yellow Clearance	3.0	4.4	3.7	3.8	3.0	4.4
Red Clearance	2.4	1.3	2.5	2.6	2.3	1.3
Red Revert	2.0	5.0	2.0	2.0	2.0	5.0
Walk 1 *	-	-	-	-	-	-
Don't Walk 1	-	-	-	-	-	-
Seconds Per Actuation *	-	-	-	-	-	-
Max Variable Initial *	-	-	-	-	-	-
Time Before Reduction *	-	-	-	-	-	-
Time To Reduce *	-	-	-	-	-	-
Minimum Gap	-	-	-	-	-	-
Recall Mode	-	MIN RECALL	-	-	-	MIN RECALL
Vehicle Call Memory	-	YELLOW	-	-	-	YELLOW
Dual Entry		-	-	-	-	-
Simultaneous Gap	ON	ON	ON	ON	ON	ON

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

OASIS and Backup Protect

- Phase Control Functions menu
- Select phase(s)

```
   OASIS LOCAL CONTROLLER MAIN MENU:
1 STATUS DISPLAYS      8 OVERLAPS
2 PHASE CONTROL        9 COORDINATION
3 PHASE TIMING         A PREEMPTION
4 PHASE SEQUENCE       B SCHEDULING
5 INPUTS               C USER PROFILES
6 OUTPUTS              D GENERAL MENU
7 DETECTORS            E EXIT
```

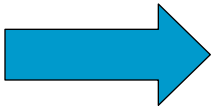
From main menu
press ‘2’ (PHASE CONTROL)

```
   PHASE CONTROL FUNCTIONS MENU:
1...PHASE CONTROL FUNCTIONS
2...DYNAMIC/BACKUP CONTROL FUNCTIONS
```

Next, press ‘1’
(PHASE CONTROL FUNCTIONS)

```
  PHASE CONTROL SET: PAGE 1 (NEXT:PAGES)
PHASE#            |123456789101112131415 16
PERMITTED         |XXXXXXXX
TIME MIN 2        |
TIME EXTENSION 2  |
TIME MAX 2        |
SOFT RECALL       |
MINIMUM RECALL    | X    X
MAXIMUM RECALL 1  |
MAXIMUM RECALL 2  |
CALL NON-ACT 1    |
CALL NON-ACT 2    |
OMIT PHASE        |
DUAL ENTRY        |
NO SKIP           |
ADDED EXTENSION   |
SIMULTANEOUS GAP  |XXXXXXX
GUAR  PASSAGE     |
GREEN INT FLASH   |
FAST GREEN FLASH  |
RED REST          |
BACKUP PROTECT    |
```

Phasing Timing data

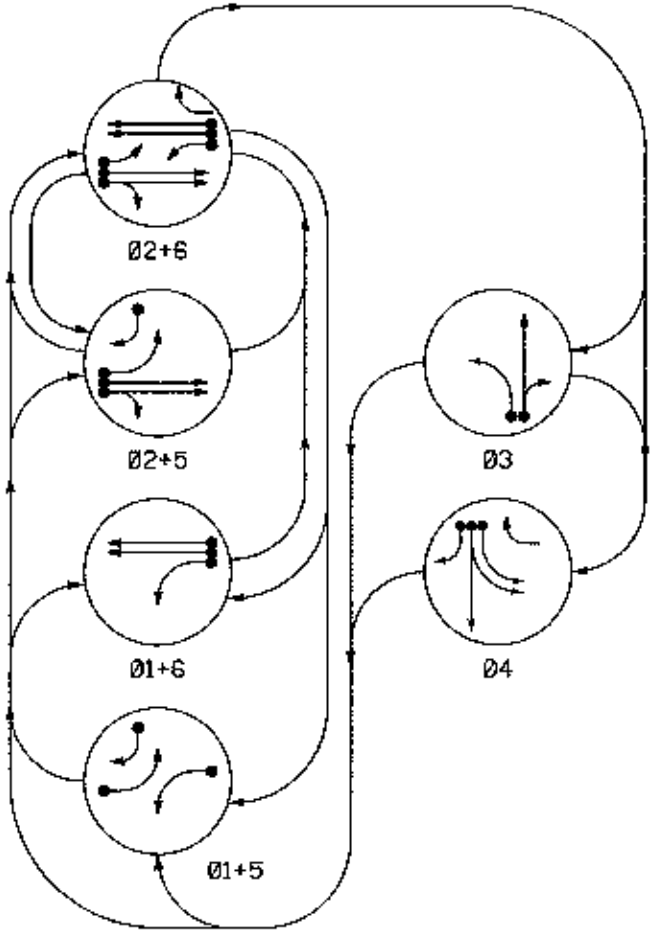


PHASE TIMING SET: PAGE 1 (NEXT:PAGES)

PHASE	1	2	3	4	5	6	→16
MINIMUM GREEN 1	10	10	10	10	10	10	
MINIMUM GREEN 2	10	10	10	10	10	10	
RESERVICE GREEN	10	10	10	10	10	10	
EXTENSION 1 (GAP 1)	3.0	3.0	3.0	3.0	3.0	3.0	
EXTENSION 2 (GAP 2)	3.0	3.0	3.0	3.0	3.0	3.0	
MAXIMUM GREEN 1	30	30	30	30	30	30	
MAXIMUM GREEN 2	30	30	30	30	30	30	
YELLOW CLEARANCE	5.0	5.0	5.0	5.0	5.0	5.0	
RED CLEARANCE	1.0	1.0	1.0	1.0	1.0	1.0	
RED REVERT	1.0	1.0	1.0	1.0	1.0	1.0	
WALK 1	0	7	0	7	0	7	
WALK 2	0	7	0	7	0	7	
DONT WALK 1	0	20	0	20	0	20	
DONT WALK 2	0	20	0	20	0	20	
WALK ADVANCE TIME	0.0	0.0	0.0	0.0	0.0	0.0	
WALK DELAY TIME	0.0	0.0	0.0	0.0	0.0	0.0	
ALTERNATE WALK	0	7	0	7	0	7	
ALTERNATE DONT WALK	0	20	0	20	0	20	
ALTERNATE MIN GREEN	10	10	10	10	10	10	
DYNAMIC MAX/MAX 3	0	0	0	0	0	0	
DYNAMIC MAX ADJUST	0.0	0.0	0.0	0.0	0.0	0.0	
SECONDS / ACTUATION	1.5	1.5	1.5	1.5	1.5	1.5	
MAX VARIABLE INITIAL	20	20	20	20	20	20	
TIME BEFORE REDUCTN	10	10	10	10	10	10	
TIME TO REDUCE	10	10	10	10	10	10	
MINIMUM GAP	0.0	0.0	0.0	0.0	0.0	0.0	
ALT FLASH FREQUENCY (0-25.5 HZ)	...0						

Signal Plan w/Backup Protect

- Phasing Diagram
- revert to red

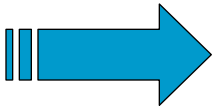


Red Revert timing

- Backup Protect alone would effectively eliminate the ‘yellow trap’
- The green-yellow-red clearance-green cycle can be misinterpreted as a malfunction
- Lengthening the Red Revert timing interval is used to minimize/eliminate any confusion

Signal Plan w/Backup Protect

- Timing Chart
- Red Revert timing



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Walk 1 *	-	-	-	-	-	-
Don't Walk 1	-	-	-	-	-	-
Seconds Per Actuation *	-	-	-	-	-	-
Max Variable Initial *	-	-	-	-	-	-
Time Before Reduction *	-	-	-	-	-	-
Time To Reduce *	-	-	-	-	-	-
Minimum Gap	-	-	-	-	-	-
Recall Mode	-	MIN RECALL	-	-	-	MIN RECALL
Vehicle Call Memory	-	YELLOW	-	-	-	YELLOW
Dual Entry		-	-	-	-	-
Simultaneous Gap	ON	ON	ON	ON	ON	ON

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Advantages of Backup Protect with Red Revert

- Avoids ‘yellow trap’
- easily enabled
- efficient

Candidates for this functionality

•Econolite Oasis local controller software

•New installations with backup protection issues

•Existing signals with upgraded phasing that introduces the need for backup protection

Railroad preemption and Backup Protect

- This function is a universal controller setting
- This function would be active when transitioning to RR preemption
- Delay could be realized when sequencing to “all-red” during transition to track clearance
- Altered Red Revert time would add additional delay

ITS and Signals Unit Design Manual

http://www.ncdot.org/doh/preconstruct/traffic/ITSS/ws/manual.html

Signal Design Tips - Backup Protection

http://www.ncdot.org/doh/preconstruct/traffic/ITSS/docs/backup.pdf

ITS and Signals Unit Design Manual

Http://www.ncdot.org/doh/preconstruct/traffic/ITSS/ws/manual.html

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